CHASSIS LUBRICATION
Lubricate for SAFETY every 1,000 MILES

The Lubrication Engineer
NATIONAL LUBRICATING GREASE INSTITUTE

VOLUME V • NUMBER 3 JUNE, 1941

Servicing Power Shift Vacuum Cylinders

By Walter E. Blaine
Field Editor of CHEK-CHART

Vacuum operated power mechanism, used to reduce the effort required to operate transmission gear shift, was introduced by Graham in 1938. Chevrolet first used the mechanism, which is standard equipment on current models, in 1939. Other car makers offer gear shift vacuum equipment as optional equipment on 1941 models.

While the designs used on different makes are not identical, the principle of operation is essentially the same in that the creation of unbalanced pressures between the two ends of the vacuum cylinder causes movement of the piston, which in turn is connected with the linkages operating the rods and levers controlling the gear shift positions.

There is little likelihood of improper functioning of the unit, because of its simple design and construction. While there are a number of rods and linkages that must be accurately adjusted and connected, this is done at time of assembly and readjustments are seldom necessary. The only points that may require lubrication, except possibly a periodic application of motor oil to clevis pins, are the piston within the cylinder and the reactionary levers. Even these require lubrication only when sluggish operation of the piston occurs. Some manufacturers recommend this be done every 15,000 miles, while others say "when necessary," but all manufacturers request that this be done only at an authorized dealer's service station.

While the design and construction is not complicated, there are certain accurate valve adjustments within the cylinder piston rod that must not be disturbed and for that reason, car manufacturers request that these units be referred to an authorized dealer for service.

How the Mechanism Functions

The piston rod is hollow. An inner valve rod actuates ports which allow entrance of air to either side of the piston. When the gear shift lever is in the neutral position, the valve is in a position that admits atmospheric pressure to both sides of the piston. When the gear shift lever is moved forward, as when shifting into either reverse or second speeds, the inner sleeve valve is moved forward and vacuum is applied to the forward side of the piston, and atmospheric pressure to the rear side. This results in moving the piston forward in the cylinder.

When the gear shift lever is moved backward, as when shifting to either first or third speeds, the inner sleeve valve is moved backward in the piston rod. This uncovers the rear port in the piston rod and applies vacuum to the rear of the piston at the same time the forward port is opened to atmospheric pressure, and the piston is moved backwards.

Why An Authorized Dealer Should Service

The accurate adjustments, referred to above, are those of proper location of the valves. To lubricate the piston properly, the several linkages must be disconnected because it is necessary to rotate the piston and also work it back and forth within the cylinder in order to distribute the lubricant over the entire inside surface of the cylinder. Valve adjustment is established at time of assembly and, if the clevis pin holding these linkages is removed, the links will drop down and permit possible disrupting of the valve timing, resulting in improper functioning of the unit.

There is little chance of valves getting out of adjustment if the mechanism is not tampered with by inexperienced mechanics. When valve adjustment is necessary, it will be evidenced by a slow or sluggish shift one way. This means the valve travel is insufficient to fully uncover ports to admit vacuum. Only when gear shift into any position is sluggish, is valve adjustment necessary.

From the above, it will be seen that service station personnel, unless thoroughly experienced in servicing these units, may do more harm than good in attempting this service. Don't risk losing a good customer —a short explanation to the car owner, telling him WHY an authorized dealer should do the work, will increase his confidence in you and your service.

There is one operation in connection with servicing the gear shift vacuum cylinder that all service stations can perform, and that is the cleaning of the vacuum air inlet filter. This air cleaner is attached to the frame side member and should be removed, cleaned, and re-oiled every 15,000 miles. Remove air inlet filter from side member, disconnect flexible air hose inlet, wash in kerosine, dip in Motor Oil and reassemble. This should be done at more frequent intervals than every 15,000 miles in dusty areas.

Get Out and Get Under!

"Courtesy The Diamond"

Mid Continental Petroleum.

SPRING IS HERE and it's *Time to Change!*

"Get Out and Get Under" is a campaign slogan which every Station Salesman should adopt as a challenging cry to bring about increased sales and *more profits* during the Summer months.

The annual Spring Change-Over campaign provides the occasion for putting into practice a more extensive, enlarged program of service and merchandising. The modern Service Stations can completely serve and supply all needs of the average motorist and his automobile. Therein lines the opportunity for Plus Profits.

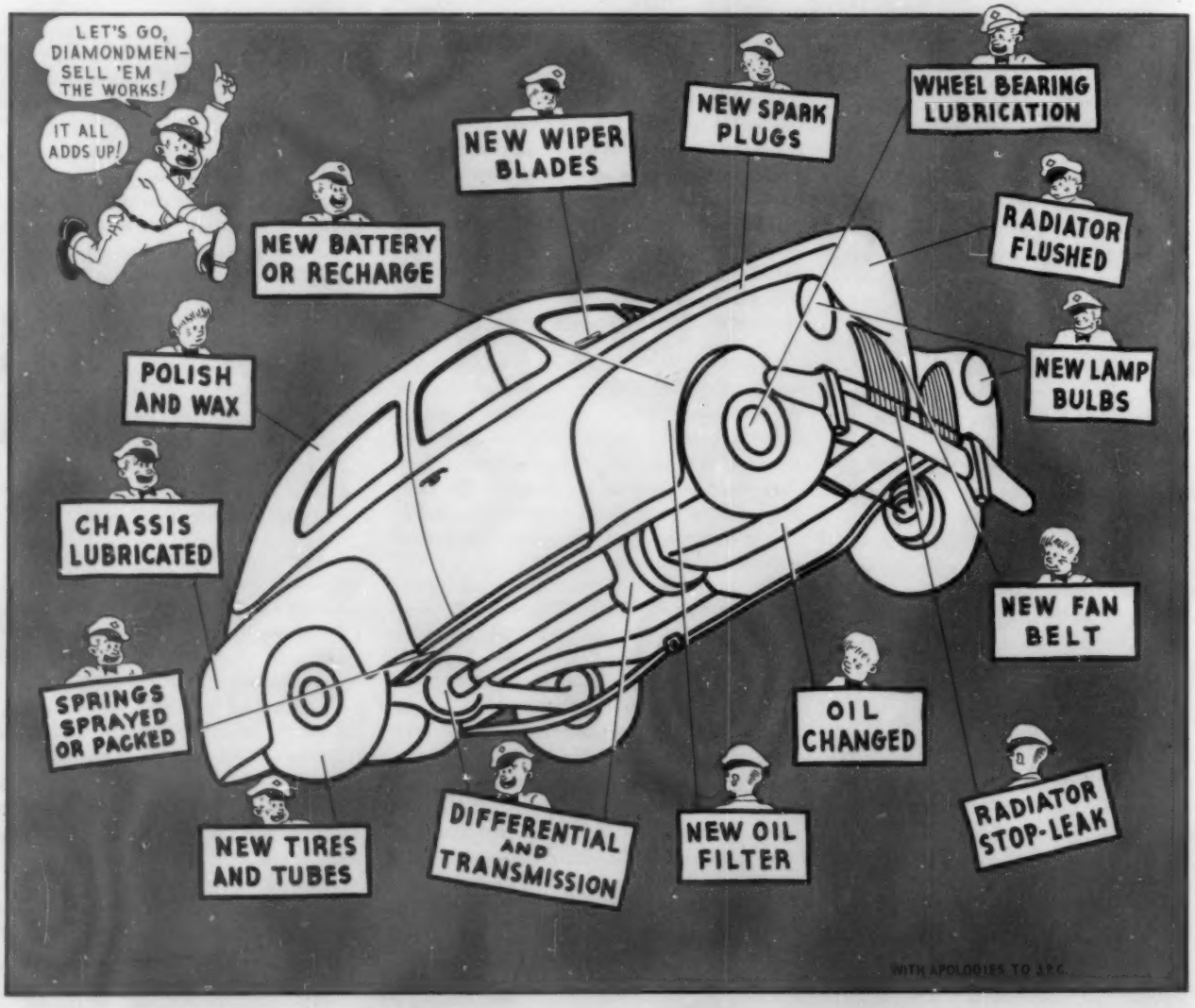
Each Dealer has the duty and opportunity of utilizing his station's facilities to the fullest. Equipment and skill in servicing motor vehicles is a "stock in trade" for successful merchandisers and dealers everywhere have the backing of a nationwide "Lubricate for Safety Every 1,000 Miles" campaign, which incites the interest of all car owners and opens unlimited opportunities for sales.

There is no way of actually knowing how much money will be spent for Spring Change-Over, but most estimates place the figure at more than $200,000,000. That would mean an average expenditure of between $6 and $7 per motor vehicle. This market is ready-made—just waiting for the Dealer who will cultivate it!

It may seem a waste of time to mention it but Service Stations are maintained to *sell something besides gasoline.*

Lubrication is a major profit factor for successful dealers and there is no better time than the present to establish car lubrication and oil-change sales records at your own station.

And as for the other Plus Profit items in the line—tires, batteries, spark plugs, auto lamps, wiper blades, car polishes, fan belts, etc., well—there's a real market for such sales and services RIGHT NOW. The market is there; the need is there; all that remains for the Dealer to do is to go out and get the business . . . to do the job . . . to GET OUT AND GET UNDER right now!



*Rationalizing Lubricating Greases**

By MARTIN B. CHITTICK
The Pure Oil Company

The problems pertaining to the satisfactory lubrication of automotive, industrial, and agricultural equipment have increased tremendously in recent years largely as a result of technical progress in metallurgy, new and improved engineering design, and technical developments in the field of lubricants themselves. These problems are of vital interest, not only to the manufacturer of lubricants, but equally important to the manufacturer of automotive, industrial, and agricultural equipment, as well as to the operators of this equipment.

How important the subject products have become may be measured by the yardstick of annual consumption which in a recent survey indicates that the potential volume of grease is approximately 560,000,000 per year.

There appears ot be a general tendency in any consideration of lubricants to think largely in terms of lubricating oils from petroleum. This, no doubt, is due to the fact that the large portion of total lubricants is represented by the oils. This attitude is unfortunate for producer and consumer alike in that proper consideration, as indicated by research and publication of papers, has not been given to that large and important group of lubricants commonly referred to as lubricating greases. As a matter of fact lubricating greases have been "The Last of the Mohicans" insofar as petroleum products have been concerned. This is rather startling when it is recalled that lubricating greases were used long before petroleum was known. Lange (1) has pointed out that the first evidence of bearing lubrication dates back to the original chariot carts in the 14th and 15th centuries B. C. The official chemist of the Cairo Museum reports his examination of the deposit found on the axle of a chariot from the time of Yuss, about 1400 B. C. It is interesting to note that this analysis showed, besides deposits of quartz and iron, sufficient fat and lime to prove the use of lime soap at that time.

In more modern times and with the commercial production of lubricating oils from petroleum came an improvement in lubricating greases through the incorporation of these oils with the metallic soaps.

NOMENCLATURE

The American Society for Testing Materials has defined a lubricating petroleum grease (2) (A.S.T.M. Designation: D288-39) as "a semi-solid or solid combination of petroleum product and a soap, or mixture of soaps, with or without fillers, suitable for certain types of lubrication." This definition while good as far as it goes, does not cover the entire field of products commercially known as lubricating greases, therefore the scope of this paper is not limited to products falling within the limits of the official definition. The well known cup grease and pressure gun grease will serve to illustrate the lubricants covered by the A.S.T.M. definition. Since we are at present concerned with rationalizing the subject matter those products not covered by the definition must also be considered. Two outstanding examples of these are found in the so-called extreme pressure lubricants and the tractor roller bearing greases. In the former are the sulfurized, phosphorized, and chlorinated fatty oil types. At the same time within the extreme pressure lubricants is found the lead soap active sulfur type which fully meets the A.S.T.M. definition.

The tractor roller greases are admixtures of mineral oil containing varying proportions of abrasive-free asbestos floats as thickening agents.

This inconsistency in nomenclature and definition, therefore, offers an initial opportunity to rationalize for certainly only further confusion and misunderstanding can result from lack of definite and a technically accurate description of the products involved. The following definition has been suggested: "A lubricating grease is a lubricant having a composite viscosity structure."

A careful analysis of the situation can lead to but one conclusion, namely, that the term "grease" is generic and out dated, therefore, not only incapable of correct technical definition but also non-descriptive.

The time is apropos to consider seriously deleting the term "grease" from our technical nomenclature applying to lubrication and substituting the accurate, descriptive and simple term "lubricant" to apply to all products used to reduce friction and prevent wear between moving surfaces.

This author suggests in Table No. 1 such a classification for consideration that group all lubricants in three classes by name or simple definition.

TABLE NO. 1

LUBRICANTS

I	II	III
Mineral Oils.	Mineral Oils in admixture with other agents in which the viscosity of the mixture is not greater than that of the mineral oil.	Mineral Oils in admixture with thickening agents, such as metallic soaps or other materials, in which the viscosity is greater than the mineral oil.

Under such a system lubricating greases falling within the official A.S.T.M. definition would obviously fall into Class III lubricants.

Quite frequently through the development period of new lubricants phrases and terms are evolved, usually descriptive that later boomerang and contribute to confusion and misunderstanding. We may take as a good example of this those lubricants developed the past few years for service involving high pressure conditions. The term "active extreme pressure lubricants" and "mild extreme pressure lubricants" developed. Only lately has the trend developed to refer to these products as light duty and heavy duty extreme pressure lubricants and to these may be added "Universal Gear Lubricants." Rather than resulting in clarification such practices only contribute to further confusion and misunderstanding. This may be all well and good for the technologists who are in close touch with developments, but what about the consumers whose problem is to keep equipment lubricated and who are entitled to simple, understandable, and rational nomenclature?

EVALUATION

In any discussion of lubricating greases it is only logical that their primary function, namely, to reduce friction and excessive wear, be considered in relation to lubricating oils. In general, lubricating greases are employed where the operating conditions are such as to make lubrication by oil impossible or undesirable. Mechanical systems without oil-tight housing, open gears, and conditions of high operating temperatures, offer typical examples in such cases.

The rapidly changing picture in development of mechanical equipment and the wide variety of commercial products that have found their way on the market as lubricating greases has lead to considerable delay in developing acceptable procedures for testing greases. Those tests that have enjoyed commercial acceptance have in general been developed under the sponsorship of the American Society for Testing Materials. The U. S. Bureau of Standards has contributed others and these are covered by reference (2) (3) (4) appended to this paper.

These tests have been supplemented by individual tests developed in various laboratories and which can be classified according to the various physical and chemical properties of grease.

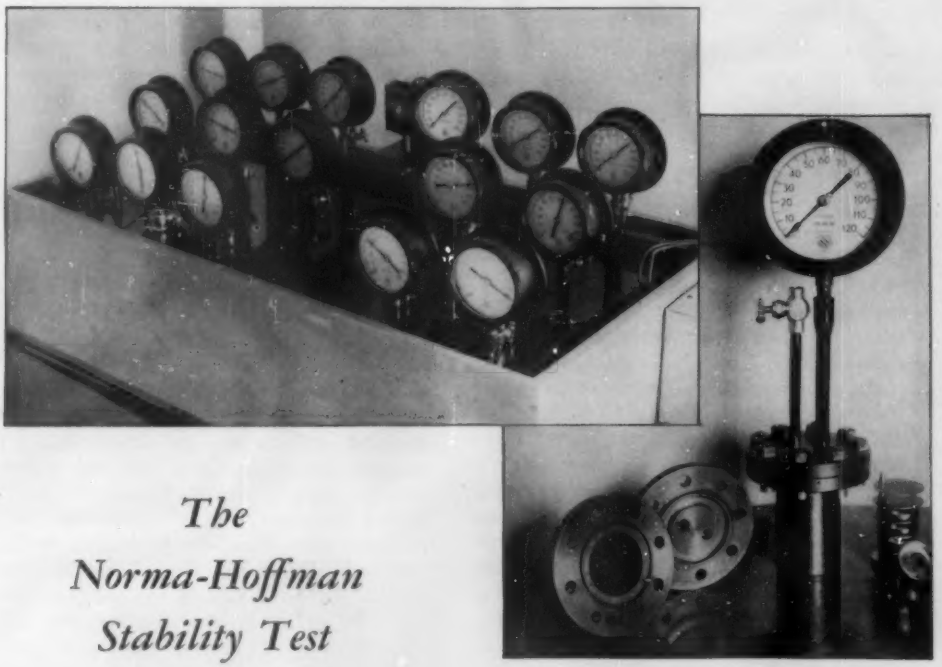
Existing laboratory procedures for evaluating this class of lubricants are insufficient

(Continued on page 6)

*Courtesy Society Automotive Engineers

Evaluation of Ball and Roller Bearing Greases

(Continued from May Issue)



The Norma-Hoffman Stability Test

This is a static test for study of accelerated oxidation of greases. It is based upon the fact that oxidation of petroleum products, fatty oils, and lubricating greases, usually occurs in two stages. Norma-Hoffmann Bearings Corp. have done some interesting work in studying this type of oxidation, through the cooperative efforts of Messrs. F. L. Wright, H. A. Mills and W. A. Lutz in papers on "Some Applications of an Accelerated Test for Determining the Chemical Stability of Lubricating Greases,"* and "An Accelerated Oxidation Test for Chemical Stability of Lubricating Greases."** In principle, they have developed a mechanism which measures the rate at which oxygen is absorbed in oxidizing the readily oxidizable constituents in the grease sample. As two stages of oxidation are involved, they have termed the first step the "induction period." During this period a comparatively slow reaction rate occurs with relatively slight changes in the chemical properties of the materials under test. With many greases there is a sharp change in this rate of oxidation, indicated by a definite increase in the reaction rate. This point is regarded as the end of the induction period and the beginning of the second period. One is most concerned with the length of time involved during the induction period, as this is indicative of the stability of the grease under test.

The apparatus consists of a stainless steel bomb and a suitable constant temperature bath. For convenience, this bath is made large enough to hold several bombs. The bomb is fitted with a suitable valve for flushing and filling with oxygen, and is equipped with a pressure gauge to indicate drop in pressure resulting from the absorption of oxygen by the sample of grease that is put in the bomb. Grease samples weighing 20.00 ± 0.01 grams are spread in a uniform layer, over the surface of containers of glass or metal similar to that which is likely to contact the grease in actual service. The cups holding the grease samples are suspended on 18-8 stainless steel holders. Closure of the bomb is effected by bolting down the cover plate, a lead gasketed tongue and groove joint assuring pressure tightness.

When the bomb has been assembled for testing it is flushed by filling with oxygen and allowing the oxygen to escape. This is done at least five times, after which the bombs are filled with oxygen to approximate the pressure to be used, making allowance for the pressure increase that will occur when the bomb is heated to the testing temperature of 175 or 210 degrees Fahr. The bomb is then immersed in the constant temperature oil bath which is provided with agitation, and is thermostatically controlled to maintain the temperature within plus or minus 0.5 degrees Fahr., of the desired figure. When the bomb reaches constant temperature, usually within two hours, the oxygen is gassed off to the exact pressure selected for the start of the run, usually 110 pounds gauge.

(Continued on page 5, col. 1)

SHIPPING CONTAINERS FOR ALL LUBRICANTS

•

The Draper Manufacturing Co.
Cleveland, Ohio

"Business is Ingreasing"

BATTENFELD GREASE & OIL CORP.

KANSAS CITY, MO.
MINNEAPOLIS, MINN.
N. TONAWANDA (Buffalo) N. Y.

•

Manufacturers of

BAT'S GREASES

exclusively for Refiners and the Jobbing Trade

SWAN-FINCH OIL CORP.

RCA Building 201 N. Wells St.
New York N.Y. Chicago, Ill.

Manufacturers

Lubricating Oils — Greases
Foundry Core Oils

The INSTITUTE SPOKESMAN

Published monthly by

THE NATIONAL LUBRICATING GREASE INSTITUTE

GEORGE W. MILLER ..... *Editor*

498 Winspear Avenue, Buffalo, N. Y.

Associate Editors

J. R. Battenfeld — W. H. Oldacre
M. B. Chittick — W. H. Saunders
E. V. Moncrieff — H. C. Vesper

OFFICERS

President: FRANK C. KERNS, The Texas Co.
Vice-Pres.: SYDNEY BEVIN, Fiske Bros. Refining Co.
Treasurer: E. V. MONCRIEFF, Swan-Finch Oil Corp.
Executive Secretary: G. W. MILLER, Battenfeld Grease & Oil Corp. of N. Y.

DIRECTORS

J. R. BATTENFELD, Battenfeld Grease & Oil Corp.
J. R. CORBETT, Cato Oil & Grease Co.
L. P. LOCHRIDGE, Sinclair Refining Company
SYDNEY BEVIN, Fiske Bros. Refining Company
CARL W. GEORGI, Enterprise Oil Co.
C. B. KARNS, Standard Oil Co. of N. J.
WM. H. OLDACRE, D. A. Stuart & Company
B. C. VOSHELL, Socony-Vacuum Oil Co., Inc.
M. R. BOWER, Standard Oil Co., Ohio
M. B. CHITTICK, Pure Oil Company
H. C. VESPER, Standard Oil Co., California
WM. H. SAUNDERS, JR., International Lubricant Corp.
R. H. PATCH, E. F. Houghton & Co.

The Norma-Hoffman Stability Test

(Continued from page 4)

During the test the pressures are recorded every two hours. These are plotted against time, either on standard coordinate paper or on logarithmic paper. A sharp break in the time-absorption curve indicates the end of the induction period.

Some of the factors found to have an effect on the oxidation of grease when tested by means of the accelerated oxygen absorption method are oxygen concentration, the temperature at which the oxidation test is run, and the catalytic agents present in the form of metals in contact with the grease.

One which is satisfactory for ball and roller bearing lubrication will show no noticeable change in color, consistency, or appearance until the end of the induction period is approached, nor will there be any decided increase in acidity. After the grease begins to absorb oxygen more rapidly, however, it will quickly darken, turn rancid, perhaps separate oil, and show a decided increase in acidity.

* See proceedings of the American Society for Testing Materials, Vol. 38, Part II, 1938.

** A paper prepared for The Bearing Engineers Committee on lubrication.

*Car Manufacturers' Recommendations**

NEW WILLYS MODEL WITH TRANSMISSION OVERDRIVE

Willys is now offering transmission overdrive as optional equipment. Willys models equipped with overdrive are known as "Plainsman" models and a chrome plate with the name "Willys Plainsman" appears on the side of the hood.

No new block of serial numbers has been assigned to those units equipped with overdrive. However, the first car so equipped carried serial number 441-60978.

Transmission and overdrive units have individual drain plugs and filler plugs. When filling, first fill overdrive unit to plug level; capacity 2 pt. or lb. Then fill main transmission case to plug level; capacity 1 pt. or lb. It is important that the overdrive unit be filled first, due to the fact that the plug hole in the overdrive case is somewhat higher than that in the main transmission case. The transmission and overdrive units are inter-connected with a complete oil circulating system between the assemblies.

Fluid Gear Lubricant SAE 90 is recommended Summer and Winter down to —10° F.; below —10° F. SAE 80 should be used. *Do not use Hypoid lubricants in transmission or overdrive.*

LUBRICATING HOTCHKISS DRIVE UNIVERSAL JOINT ON CHEVROLET TRUCKS

Info-mation has been received from the field to the effect that in some instances difficulty is experienced in properly lubricating the universal joints on the 1941 Chevrolet Hotchkiss Drive Trucks.

Due to the design of these universal joints and the location of the lubrication fitting, there is insufficient clearance to get the necessary good seat between the end of the regular Alemite gun and the lubrication fitting. The lubrication fitting can be reached with the gun, but when pressure is applied lubricant is lost between the gun and the fitting in the universal joint.

A special long adapter with a smaller outside diameter than the end of the Alemite gun, will eliminate this difficulty or lubricant loss when lubricating these universal joints. This adapter is equipped with a sleeve which slides up over the end of the gun, insuring a leak-proof joint and proper alignment.

With this adapter, ample clearance is provided to secure the proper seat and sealing at the lubrication fitting to prevent loss of lubricant when pressure is applied. This adapter is available from distributors of Alemite Products under part No. 6307-A.

HARD WORKING OIL

Lubricating oil has a lot of work to do in the engine. It has to travel fast and be a lot of places at once. Pontiac engineers tell us that the gear type oil pump driven by the camshaft moves seven barrels of oil an hour at a car speed of 60 mph.

1941 DODGE FLUID DRIVE

Dodge D19 cars equipped with fluid coupling should be checked after 1,000 miles of operation to be sure that the level of the fluid in the coupling is correct. It is essential when checking fluid level, that the unit be allowed to cool off to room temperature because driving generates heat in the unit and expands the fluid.

Insufficient fluid in the coupling will materially affect the economy of the operation of the vehicle. This is especially true of gasoline consumption as excessive slippage and more engine revolutions will develop as the fluid level is decreased.

WINDSHIELD WIPER ARM ADJUSTMENT—1941 PONTIAC

In case an owner complains that the windshield wiper blades do not wipe a large enough area, especially at the outer ends of the windshield, the wiper arms can be adjusted to give a wider sweep of the blades. The arms should be adjusted so that the blades are approximately 1½ in. from the bottom of the windshield in the "at rest" position. It should also be demonstrated to the owner that the blades will wipe the greatest area when the motor is turned to maximum speed.

CHEVROLET—1939-40-41 MODELS

The gear shift vacuum cylinder on these models is equipped with an air inlet filter which requires cleaning and re-oiling. Every 10,000 miles, remove air inlet filter from side rail member, disconnect flexible hose inlet, wash filter in kerosene, dip in SAE 50 and reassemble.

CROSLEY A-1939; B-1940; CB-1941

Some 1939-40 models may be found with the universal joint type torque tube, as the swivel type used in production on 1939-40 models may be replaced with the universal joint type used on 1941 models, at the car owner's request and at his expense.

NASH 6, 8—1941

The fittings for lubricating the Upper Control Arm, Inner, are more easily reached from under the hood than from under the car.

The king pins are equipped with metered fittings, that is, fittings having a small reservoir which continually feeds the king pins by spring pressure. Overlubrication is to be avoided, as high pressure will ruin this type of fitting.

NASH AMB. "600"—1941

The pedal shaft and clutch idler shaft

* Copyright Chek-Chart, Inc. Reproduction forbidden.

are packed at assembly and should be repacked as necessary (if sticking, squeaking, ect.) by a Nash dealer. Disassembly is necessary.

NEW PACKARD MODELS

A new Packard model, named the "Clipper," was introduced at a press preview on April 1.

The body of the Clipper is entirely new and departs sharply from the traditional lines of the company's conservative styling policy.

The new model, expected to be extended further when the company's 1942 model lines are introduced, features a lower body design, rakish windshield and contoured rear deck. It is powered with a straight eight cylinder engine developing 125 horsepower. The hood may be raised from either side—a new feature.

Engineering changes include a shortened propeller shaft made possible by an extension to the transmission, and the incorporation of a rear shock absorber that is said to prevent sidesway. The front suspension has been radically changed, involving a number of differences in lubrication details. The number of lubrication points has been increased.

WOOL GREASES
(Degras)
Common — Neutral — Lanolin
For All Purposes
Refined by
N. I. MALMSTROM & CO.
BROOKLYN, N. Y.

JOBBERS NOTE

Oil jobbers are discovering new summer profits in promoting sales of Cattleze insect sprays through dealers handling rural trade.

Cattleze has proved dependable for dairy and barn use in killing and repelling flies and other disease breeding insects on cows and horses. It can be easily applied with a compressed air sprayer or by hand. And it does not tend to taint milk.

The cattleze container has proved extremely popular among dairymen because it has general farm use when contents are exhausted.

Calumet Refining Co., 4323 South Western Blvd., Chicago, Illinois, makers of Cattleze, are giving jobbers the benefit of merchandising folders in addition to the attractive double-purpose packaging. — (Advertisement.)

Rationalizing Lubricating Greases

(Continued from page 3)

and no greater contribution can be made to the rationalization of lubricating greases than early development of better means of evaluating them and for the long time picture will lead to better quality greases as well as a better understanding of their properties and more intelligent application. This must come through.

RESEARCH

Considering the importance that greases occupy in the picture of complete lubrication and the amount of research that has been carried on in other fields of lubrication as compared to that on grease one must arrive at the conclusion that we are woefully lacking. Actually in some types of greases practically no change has been made in the past fifty years. It follows thru, that if we are to be rational that it is absolutely necessary to carry out more intensive research work. That this indictment may not be too severe it is only fair to state that several investigators have carried out well worth while work and have made substantial contribution to the subject.

Due to service demands, rather than initiative on the part of the grease manufacturers themselves, considerable impetus has been given research the past few years. This accounts for the better quality greases and better service performance being secured today than at any time in the past. The progress made in the development of antifriction bearings has been one of the major factors contributing to this research work. It seems rather irrational that some of the best research work on greases has come from the laboratories of the bearing manufacturers themselves rather than from the grease manufacturer's laboratory. This is particularly true as regards the chemical and physical stability of grease and mechanical testing procedure.

In any resumé of development work in connection with lubricating greases, it is patently impossible to maintain a proper proportion, first, in view of the fact of the composite nature of lubricating greases, and secondly, due to the fact that much of the development work, even though appearing relatively insignificant in the light of present-day knowledge, must nevertheless be credited with initial research work which has ultimately resulted in our current research activities with lubricants. Two methods of approach present themselves. The

(Continued on page 7)

New Swan-Finch Director

Mr. E. V. Moncrieff, President, Swan-Finch Oil Corp., announces the election of Geo. F. Phillips, of Kenefick, Cooke, Mitchell, Bass & Letchworth, Buffalo, N. Y., to its Board of Directors.

•
"Penola"
Pittsburgh, Pa.
•

TRABON
Lubricating Equipment
•
Trabon Engineering Corporation
Cleveland, Ohio

Specialized Glycerides
and
FATTY ACIDS
for
Lubricating Greases
•
THE
WERNER G. SMITH CO.
(Division of Archer-Daniels-Midland Company)
2191 West 110th St., Cleveland, O.

A Complete Line of Oils...
FOR THE GREASE MANUFACTURER
CALUMET REFINING CO.
4323 S. Western Blvd. Chicago, Ill.
Refinery, Burnham, Ill.

first and simplest would be to classify the work under the rational and general heading of physical and chemical properties. The second method would be to take up the various characteristics such as structure, consistency, chemical and physical stability, etc. The major difficulty arising in either case lies in the fact that so many investigators have presented their research work involving various phenomena so that there is considerable overlapping. I have therefore adopted an arbitrary approach with the hope that further work may be provoked and that subsequent work will tend to rationalize the entire subject. A discussion of consistency is indicated therefor for the first consideration due to the fact that this property is given wide commercial consideration.

The term "consistency" as applied to lubricating grease, refers to the flow-pressure characteristics. Actually, and in practice, the term has unfortunately been applied too loosely and with no relation to the other characteristics such as structure and texture. The A.S.T.M. Tentative Method D 21 7-38T (2) is the most widely used commercial method for determining this property. This procedure has, however, limited application since it cannot be used with any degree of accuracy on the semi-liquid greases and cannot be employed where small samples of extremely hard greases are involved. The test is, however, invaluable for maintaining uniformity of consistency on actual production and has contributed to a major degree in greater uniformity in commercial greases.

In this connection, it may be stated that consistency has been given too wide acceptance as an indication of performance in service. This is particularly true as regards leakage. This is an erroneous conception and is demonstrated by the fact that two greases, with identical consistencies but different structures, may act quite differently in identical service conditions, one functioning satisfactorily while the other may be entirely unsatisfactory.

Several investigators have studied the property of grease consistencies with the objective of developing an all-purpose procedure suitable for the entire range of consistencies and for the purpose of predicting service. Many of these suggested procedures hold promise and should be given further study. Porter and Gruse (5) have adopted a modified Bingham plastometer to measure this property. Lederer and Zublin (6) have developed a ball-viscosity method for controlling the consistency of soft and stringy greases. Arveson (7) has studied the flow of lubricating greases using the constant shear viscosimeter. This work has presented some interesting phenomena in grease behavior and is well worth further consideration. The fact that it has not been more widely used may be attributed to some extent to the initial cost of the equipment, as well as the time and expense of individual tests.

In connection with Arveson's work, it should be noted that it has been a controversial matter as to what part the viscosity of the lubricating oil incorporated in the grease plays in the actual service performances and as to what extent this service is affected by the consistency of the grease due to its soap content and the kind of soap. It is held by some authorities that the soap merely acts as a porous reservoir for holding the lubricating oil, while others maintain that the soap performs a lubricating function.

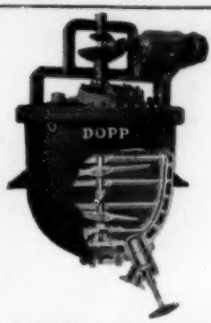
Investigations on the affect of temperature on consistency are highly desirable, particularly at the service temperatures. The A.S.T.M. penetrations are determined at 77° F. The satisfactory control of uniformity is of little or no value as affecting performance. It is quite possible that proper research in this phase would make possible the establishment of a consistency index analogous to the viscosity index of lubricating oils.

The lack of any commercially accepted standards for the various consistencies of greases has resulted in the past in considerable confusion and misunderstanding, particularly on the part of consuming interests. The National Lubricating Grease Institute has recognized this situation and has taken a most rational step to correct it by the development of a classification for lubricated greases based on the A. S. T. M. Worked Penetration. This classification is given herewith:—

National Lubricating Grease Institute Grade	*A. S. T. M. Worked Penetration*
No. 0	355-385
No. 1	310-340
No. 2	265-295
No. 3	220-250
No. 4	175-205
No. 5	130-160
No. 6	85-115

It should be pointed out that this classification in no manner indicated quality of product and in no way indicates what the chemical and physical characteristics of a grease may be other than the consistency and the standard grade for that consistency. In this respect, it is comparable to the Society of Automotive Engineers Crankcase Oil Classification, or further may be comparable to the classification of men's hats and shoes by size and in no way is a quality specification or a token of quality. It should be noted that a gap in consistency exists between each grade; consequently, there is no overlapping of grades and no possibility of one grade being substituted for another.

In this connection a precedent established by the Society of Automotive Engineers has been followed by the National Lubri-



DOPP
positively-scraped
GREASE KETTLES
and
PRESSURE MIXERS
SOWERS MANUFACTURING CO.
1295 Niagara St. Buffalo, N. Y.

LITHOGRAPHED GREASE *and* OIL PACKAGES
Steel Pails...Grease Cans... Kerosene Cans...and Lubricating Oil Containers...from one dependable source.
OWENS-ILLINOIS CAN CO.
TOLEDO · OHIO

Fats & Fatty Acids For The Grease Manufacturer
W. C. HARDESTY Co., Inc.
NEW YORK, N. Y.

Use Metasap Aluminum Stearate Bases for Clear, Transparent, Water Insoluble Greases.
Send for free copy "Meeting Modern Lubrication Demands"
METASAP CHEMICAL COMPANY
HARRISON, NEW JERSEY

cating Grease Institute. The above classification was adopted by the Institute at their Annual Convention in October, 1939, and a period of 18 months, namely, March 1, 1941, was set before this classification becomes official. This precedent was accepted to permit the consuming interests to become acquainted with the classification and to permit the manufacturer to adjust his stocks to this classification.

We may now pass to the quality of structure or texture of lubricating grease as this is one of the primary characteristics that contribute to the ultimate service performance and to a large degree is closely related to the consistency. Until recently, not too much has been known of grease structure. The general terms "smooth grease," "stringy grease," and "fibre grease" have been in commercial use for some time but, technically, little has been known of the basic reasons for these different structures.

Farrington and Davis (8) as a result of their study of texture and structure of lubricating greases, employing photomicrographs, have suggested a classification for lubricating greases based on the length of the soap fibers.

Lawrence (9) has suggested a classification of petroleum greases based on three soap oil systems which holds promise of explaining some of the phenomena observed in grease performance. This classification follows: (a) true solutions, whose viscosities may be but little greater than those of the oil alone; (b) true gel, a transparent, homogeneous elastic substance; (c) pseudo-gel or paste of crystalline soap suspended in oil.

Gruse (10) and his associates have made an excellent contribution on chemical and physical evaluation of lubricating greases in which emphasis is laid on structure and consistency, as well as the physical and chemical stability, and in which they have discussed the theories and factors affecting structure, and which indicate the necessity of further research work on structure.

The structure of lubricating grease is so interrelated with the chemical and physical characteristics that an extremely complicated problem is presented. Pertinent data are required on the effect of structure on the service performance of greases, and on why certain structures are more desirable under some applications than others. It is well known that the structure of a grease may be altered considerably by agitation under service conditions, as in the case of a soda soap grease which can be liquified at 450° F. and cooled to atmospheric temperature without agitation. This change normally results in a short fiber grease, whereas the original greases may have had a relatively long fiber. This same grease may be made tough and long fibered by heating to approximately 250° F. and working.

STABILITY

There is probably no quality pertaining to lubrication that is more important at the moment than that of stability of the lubricants. This refers not only to physical stability but to chemical stability as well. From the physical standpoint, the stability of grease towards separation of the mineral oil and soap is of primary importance and while there has been some worth-while work published on this property, which is generally referred to as "bleeding," there is much yet to be developed and research on lubricating greases will find a productive field in this problem, particularly as effected by the chemical composition of the grease and the service pressure and temperature.

REFERENCES

(1) Lange, A. R. — "Greasemaking — Past, Present & Future"—Presented before the Third Annual Convention of the Lubricating Grease Manufacturers Association, Chicago, October 14-15, 1935.

(2) 1939 Book of A.S.T.M. Standards, Part III; also "A.S.T.M. Standards on Petroleum Products and Lubricants," September 1939, available as a separate publication.

(3) "Evaluation of Petroleum Products" —American Society for Testing Materials—1940.

(4) Federal Standard Stock Catalogue, Section IV, Part 5, October 2, 1934.

(5) Industrial and Engineering Chemistry, Vol. 17, No. 9, September (1925), page 953.

(6) Lederer, E. R. and Zublin, E. W.— "Consistency Control of Soft and Stringy Greases"—National Petroleum News, Vol. 25, No. 39, page 36 (1933).

(7) Industrial and Engineering Chemistry, Vol. 24, page 71, (1932).

(8) Industrial and Engineering Chemistry, Vol. 28, page 14, April 1936.

(9) Journal of Petroleum Technology, Vol. 24, No. 174, April 1938, pages 207-220.

(10) Gruse, W. A., Lutz, W. A. and Ambrose, H. A. — "Chemical and Physical Evaluation of Lubricating Greases"—Sixth Annual Convention, National Lubricating Grease Institute, October 1938.

(To be continued)

"Good Oil is essential to good grease"

DEEP ROCK
"G" Cylinder Stock
Dewaxed Bright Stocks
and Neutral Oils

DEEP ROCK OIL CORPORATION
155 N. Clark St. Chicago, Ill.

STEEL DRUMS and PAILS

Laboratory tested—Modern design for utility and strength—Label lithographed on the metal in colors—A real sales-builder for your product.

WILSON & BENNETT MFG. CO.
6532 S. Menard Ave., Chicago, Illinois
JERSEY CITY • NEW ORLEANS

GREASE & OIL PACKAGES

For the Grease & Oil Industry

WACKMAN WELDED WARE CO.
ST. LOUIS, MO.

Chek-Chart
AUTOMOTIVE LUBRICATION ENCYCLOPEDIA

Recognized Headquarters
for
Authentic Automotive Information

The Chek-Chart Corporation
624 S. Michigan Ave. Chicago, Ill.